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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
RESEARCH AND TECHNOLOGY RESUME

TITLE

Theoretical Spectroscopy of Comets

PERFORMING ORGANIZATION

Astronomy Program
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INVESTIGATOR'S NAME

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DESCRIPTION *(a. Brief statement on strategy of investigation; b. Progress and accomplishments of prior year; c. What will be accomplished this year, as well as how and why; and d. Summary bibliography)*

a. Strategy We calculate theoretical spectra of various emitting species in cometary comae both to investigate physical parameters that are measureable with cometary spectra and to provide fluorescence efficiencies for the derivation of abundances from fluxes.

b. Progress and Accomplishments 1987-1988. (i) Completed paper on NH. NH is much further from nucleus than previously thought and, because previous fluorescence efficiencies were much too high, NH is 5 times more abundant than previously thought. (ii) Analyzed spectrum of S_2 in comet I-A-A. Despite its short lifetime, S_2 reaches fluorescent equlibrium. The equilibrium spectrum matches the relative band strengths in IUE spectra much better than does single cycle fluorescence. Equilibrium (but not single-cycle) flurescence also predicts strong optical emission bands which are seen in ground-based spectra of comet I-A-A. Equilibrium fluorescence efficiencies are much higher than single-cycle fluorescence efficiencies implying S_2 only half as abundant as previously estimated. (iii) Fluorescence spectrum of SO calculated and compared with several IUE spectra including those in which Wallis and Krishna Swamy claim SO to be present. Relative intensities and shapes of bands are inconsistent with any real identification. Upper limit on SO column density roughly 20 times column density of S_2 ; not a useful limit for chemical models.
(iv) Completed an updated analysis of fluorescence by OH including studies of the Greenstein effect and quenching the Λ-doublet inversion. The Greenstein effect was measured in old IUE spectra of Comet Encke (1980) and used to show that the radial component of the non-gravitational force is very asymetric about perihelion.

c. Tasks for Next Year (i) Complete papers for items 2 and 3 above. (ii) Model infrared (TKS-Vega) spectrum of Halley to determine relative contributions of OH fluorescence, nascent OH created in excited vibrational/rotational states, and H_2O. (iii) calculate synthetic spectra of CH for comparison with ground-based data. (iv) Study additional factors affecting the NH spectrum (eg. infrared emission by dust in the coma) and consider the levels in more detail to search for laser/maser action as suggested by Litvak.

d. Publications 1987-1988

Theoretical Specroscopy of Comets - NAGW 902

Kim, S.J. A'Hearn M.F. and Cochran, W.D 1988, NH Emissions in Comets: Fluorescence vs. Collisions, Icarus, in press.

A'Hearn, M.F. 1988, Comets in A Decade of Uv Astronomy with IUE, in press.

Schleicher, D.G. and A'Hearn, M.F. 1988, The Fluorescence of Cometary OH, Ap.J. in press.

A'Hearn, M.F. and Schliecher, D.G. 1988, Comet P/Encke's Non-Gravitational Force , Ap.J. Letters in press.

Kim, S.J. A'Hearn, M.F. and Larson, S.M., 1988 S_2 Fluorescence Processes, manuscript being edited for submission to Icarus.

Kim, S.J. and A'Hearn, M.F. 1988 Upper Limit on the Abundance of SO in Comets I-A-A and Halley, manuscript being edited for submission to Icarus.

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Abstracts of talks not included.